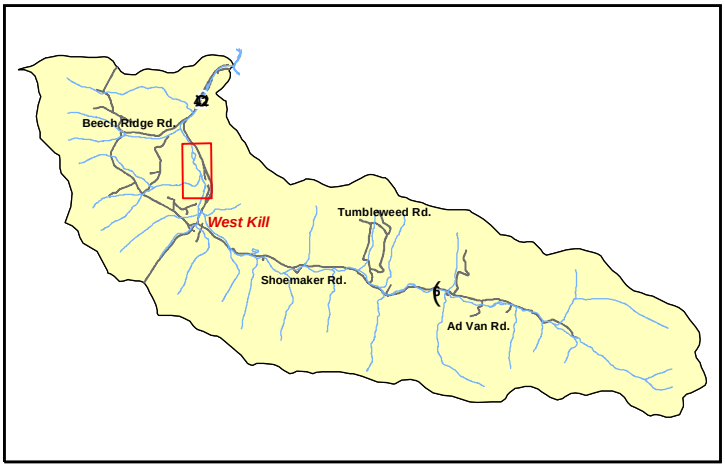


West Kill Management Unit 17

Stream Feature Statistics

36% of stream length is experiencing erosion
20% of stream length has been stabilized
35.9 acres of inadequate vegetation within the 300 ft. buffer
0 ft. of stream is within 50 ft. of the road
0 houses located within the 100-year floodplain boundary

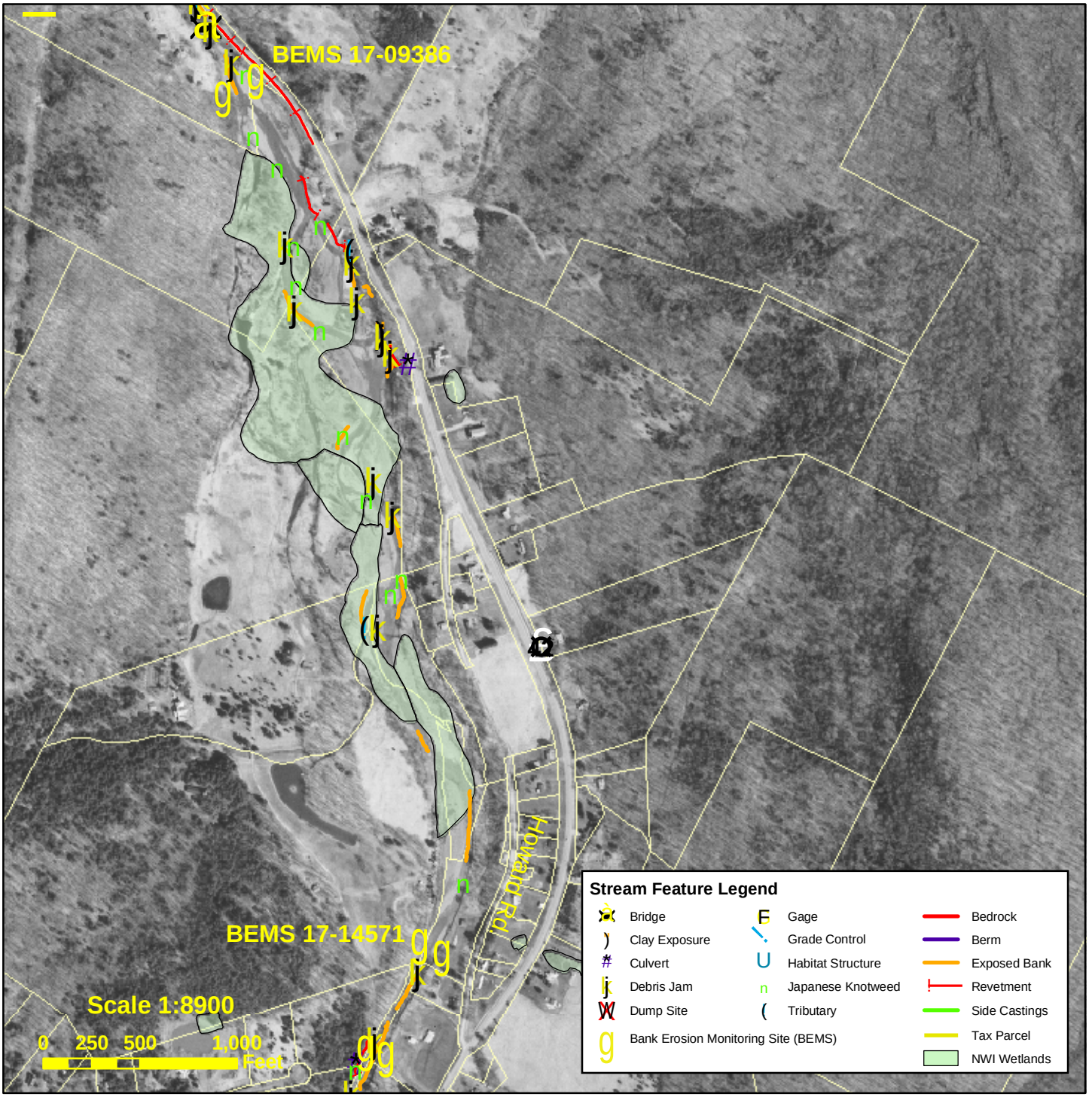


Figure 4.17.1 2004 aerial photography with stream feature inventory and tax parcels

Management Unit 17

Between Station 14742 and Station 9304

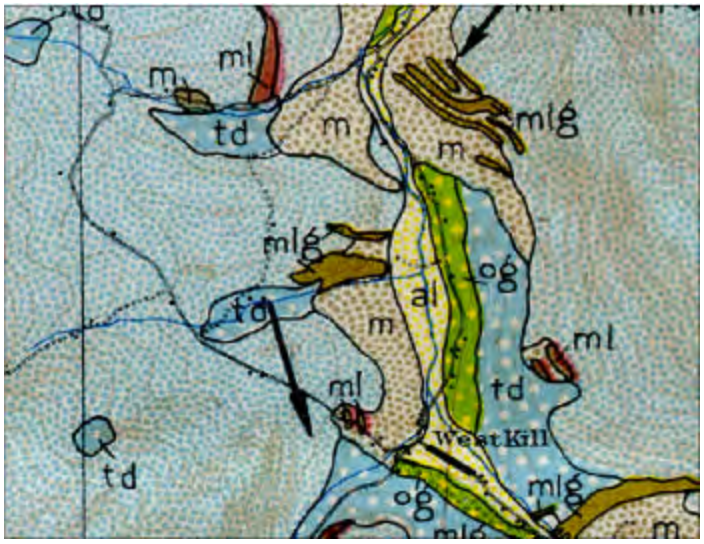
Management Unit Description

This management unit begins near the junction of Howard Road with NYS Route 42, continuing approximately 5438 ft., ending 230 ft. upstream of Lady's Bridge. The drainage area ranges from 23.5 mi^2 at the top of the management unit to 26.9 mi^2 at the bottom of the unit. The valley slope ranges from 1.65% at the upstream end of the unit to 0.83% at the downstream end of the unit.

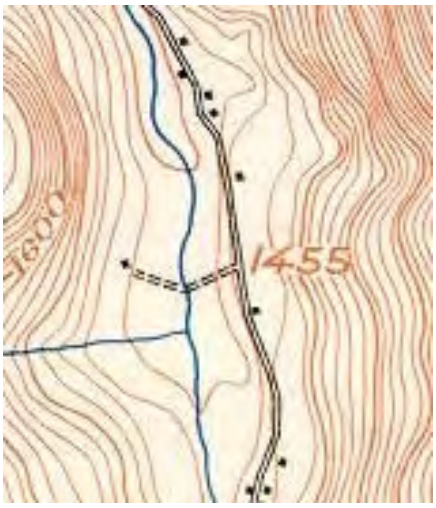
Summary of Recommendations Management Unit 17	
Intervention Level	Assisted Self-Recovery
Stream Morphology	None
Riparian Vegetation	Improve buffer along NYS Route 42. Watershed-wide knotweed eradication program.
Infrastructure	Develop multi-institutional strategy for embankment stabilization and buffer improvement.
Aquatic Habitat	Watershed wide study
Flood Related Threats	None
Water Quality	None
Further Assessment	Continued monitoring of BEMS 17-09386. Explore possibility of developing a stable channel morphology in this unit.

Historic Conditions

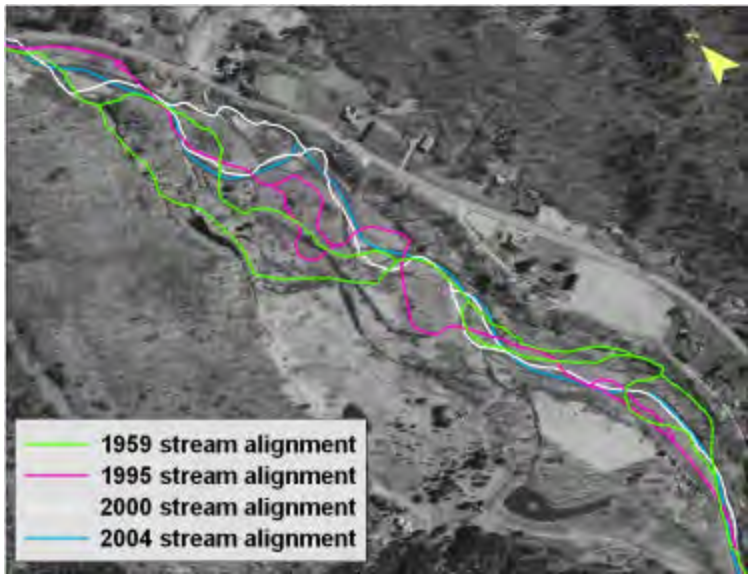
As the glaciers retreated about 12,000 years ago, they left their "tracks" in the Catskills. See Section 2.4 Geology of the West Kill Creek, for a description of these deposits.



Excerpt from Rich, 1935



Excerpt of 1903 USGS topographic map MU17



Historic Stream Channel Alignments in MU17

As seen from the historical stream alignments, the channel alignment has changed drastically over the years. Relic channels and meander scrolls throughout the unit indicate a long history of lateral extension and channel avulsion. The channel and flood plain is repeatedly reworked by even modest flood events.

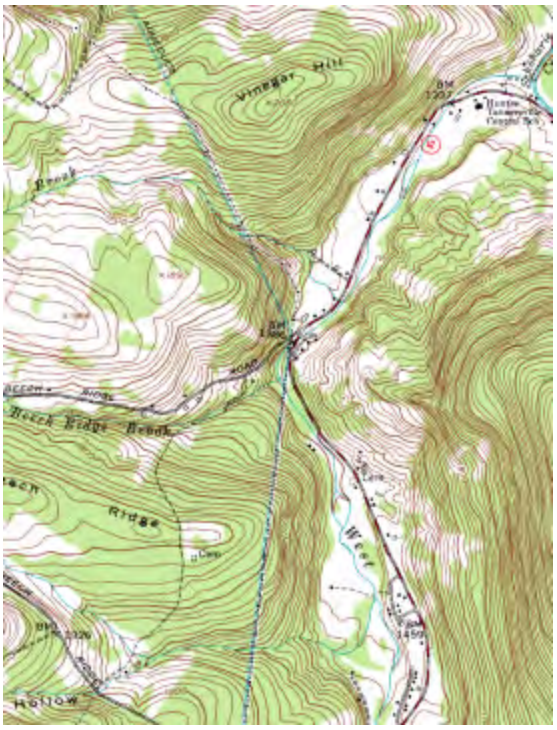
Stream Channel and Floodplain Current Conditions

Revetment, Berms and Erosion

The 2004 stream feature inventory revealed that 36% (1967 ft.) of the stream exhibited signs of active erosion along 5438 ft. of total channel length (Fig. 4.17.1). Revetment has been installed on 20% (1095 ft.) of the stream. No berms were identified in this management unit at the time of the stream feature inventory.

Stream Morphology

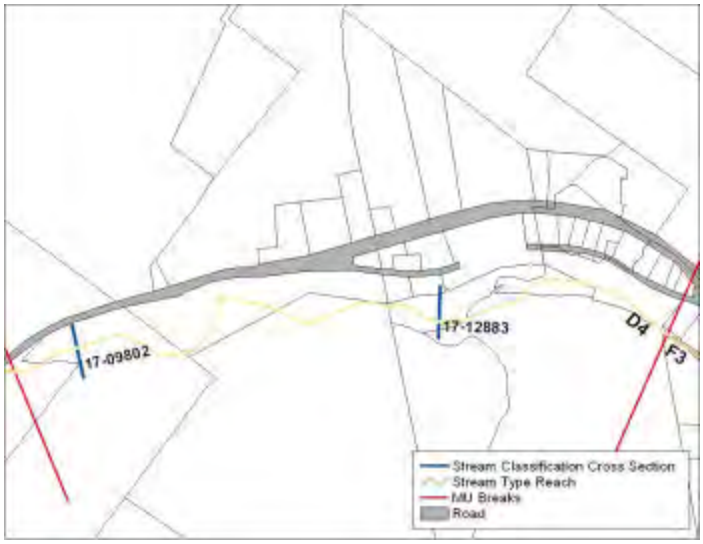
The following description of stream morphology references insets in the foldout Figure 4.17.2. "Left" and "right" references are oriented looking downstream. Stationing references, however, proceed upstream, in feet, from an origin (Station 0) at the confluence with the Schoharie Creek at Lexington. Italicized terms are defined in the glossary. This characterization is the result of surveys conducted in 2004 and 2005.



Excerpt of 1980 USGS topographic map

In Management Unit 17, a dramatic broadening of the floodplain and sudden reduction in confinement results in the widest floodplain in the West Kill watershed. This location was subject to complex interactions between continental and alpine glaciers, producing a significant reduction in valley slope. The resulting ineffective sediment transport conveyance has made Management Unit 17 the predominant sediment storage area in the watershed.

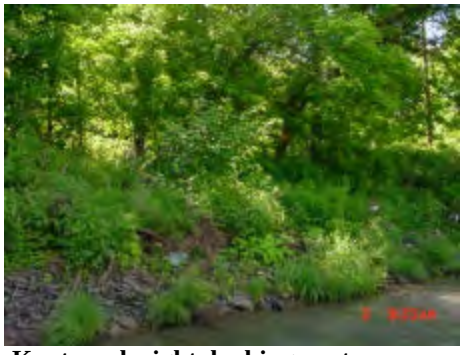
Stream morphology, or shape (i.e., slope, width and depth) remains consistent throughout this unit, creating a continuous reach of homogeneous, yet chaotic, morphology (See Section 3.2 for description of stream types).



Cross-sections and Rosgen stream types in MU17

Management Unit #17 consists of a single 5438 ft. reach of D4 stream type. The channel is *braided*, having multiple channel threads at bankfull flows. The channel slope ranges between 0.6% and 1.1% and the bed material is dominated by gravel. Accelerated gravel deposition results in frequent channel shifts, leaving numerous relic channels, mid-channel and lateral bars, and cut banks. Lines of willow are frequently found running diagonally across the channel, an indication of former water's edge.

BEMS 17-14571 is located on the right bank at the start of Management Unit 17. In a prioritization of twenty-one BEMS sites throughout the West Kill watershed (see Section 3.3, Watershed Inventory and Assessment), this site was ranked Low Priority. The *thalweg*, or deepest part of the stream channel flows up against the alluvial terrace here. The terrace is being undermined by toe erosion, leaving sections of the stream bank unvegetated.



Knotweed, right, looking upstream

A small isolated stand of Japanese knotweed was observed on the right bank. A few similar stands are located elsewhere in the area. During the 2004 inventory, 12 stands of Japanese knotweed (*Fallopia japonica*), an invasive, exotic shrub species that can grow rapidly to crowd out more appropriate streamside vegetation, were observed throughout management unit 17. In the 2005 inventory, the number had increased to 31. A program for eradication of Japanese knotweed throughout the West Kill valley is recommended.

Bank erosion is evident along 369 ft. of the alluvial terrace to the right (Inset D, Fig. 4.17.2). The erosion is mild, and yields relatively small amounts sediment. This erosion was not monumented as a Bank Erosion Monitoring Site.

Bank Erosion

Aggradation

Headcut

Continuing downstream, alternating reaches of aggradation and headcutting are observed, often promoting bank scour where the channel approaches the alluvial terrace on either side.

Bank erosion, left

Transverse flow across the headcut results in toe scour and 124 ft. of bank erosion on the left bank. Aggradation is again noted immediately downstream of the exposed bank (Inset H, Fig. 4.17.2).

High water temperatures associated with the aggradational setting may present a thermal barrier to fish migration. Thermal impacts in this unit should receive special attention in a watershed wide habitat study.

Aggradation

A monumented cross-section at Station 12883 documents the D4 stream type that predominates this unit.

Debris Jam

A debris jam has accumulated on a center bar at the channel divergence, presenting no obstruction at low flow, but a major obstruction at high flow. The jam is comprised of large woody material, not easily floatable.

An unnamed tributary enters from the left, draining the 2.2 mi^2 Condon Hollow subbasin. This confluence may deliver only a portion of the Condon Hollow discharge; other confluences on the left may deliver the remainder. The confluence is well-connected, well-vegetated, and very stable.

Tributary, left

Bank erosion

Downstream of the confluence, the low terrace banks on both sides of the channel are experiencing erosion (Inset G , Fig. 4.17.2). Erosion at the left is scouring the toe of a recently deposited spoil pile. Erosion at the right leaves vegetation from a more mature riparian buffer over-hanging the channel.

Bank erosion, right

Knotweed on meander scroll

Knotweed occurrences are noted throughout this management unit.

Knotweed on center bar

Bank erosion, right

Bank erosion is evident on the right bank downstream of a pool formed at the convergence of two channel threads (Inset C, Fig.4.17.2).

Soil stratification

Cutting of the low terrace on the right reveals soil strata deposited under varying flow conditions. This bank has a relatively low sediment yield.

Debris jam

Downstream of the bank erosion, two debris jams are identified. The first is found at the downstream end of the erosion at the right bank, and provides some measure of bank protection, while creating only a minimal flow obstruction.

Debris jam

A second jam lies at the head of a center bar. Much of the debris is well anchored by deposited gravel.

Channel divergence

The channel diverges into multiple threads around this center bar.

Knotweed

Several small stands of Knotweed are observed on the bars throughout this area.

Channel convergence

Bank erosion, left

As the channels converge at the tail of the center bar (Inset F, Fig. 4.17.2), 133 ft. of erosion is evident on the low terrace at the left.

Knotweed

Knotweed was observed atop the eroded terrace. Channel shifting prevents colonization by anything other than herbaceous vegetation on the banks and floodplains of this unit. Knotweed is likely to out-compete more appropriate riparian species in these continuously disturbed conditions.

Severe aggradation

Throughout the unit, severe aggradation exacerbates bank erosion as seen here at the toe of a large rip-rap installation on the NYS Route 42 embankment (Inset B, Fig. 4.17.2).

Bank erosion at toe of rip-rap

Debris jam

The erosion has further destabilized the mature riparian forest between the channel and the rip-rap, creating a large debris jam at the downstream end of the revetment. Erosion similar to that seen here threatens the embankment at various locations through the next 600 ft. downstream.

Culvert

A culvert carrying drainage away from NYS Route 42 outfalls from the right onto this steep embankment. Stormwater conveyed by this culvert is likely to saturate this slope, potentially destabilizing it further.

Debris jam

Numerous debris accumulations are found on a large center bar, and in the channels surrounding it, between Stations 11200 and 10200.

Headcut

At some locations these accumulations of woody material exacerbate aggradation, resulting in headcuts and bank scour.

Clay Exposure

Where channel scour is severe, lacustrine clay deposits have been exposed, evidence that this valley was once a glacial lake bed.

Tributary, right

As the valley begins to narrow, multiple channel threads converge. A small unnamed tributary enters from the right. The confluence is steep, but well vegetated.

The right bank downstream of the tributary is nearly continuously armored with large rip-rap through the remaining 1100 ft. of the unit.

Rip-rap, right

Rip-rap, NYS Route 42 embankment, looking upstream

Two installations protect residential properties adjacent to the stream (Inset A, Fig. 4.17.2), while a third armors the NYS Route 42 embankment at the right edge of the floodplain.

Aggradation

In the final reach of the unit, the valley pinch-point at Lady's Bridge results in aggradation from backwatering upstream of the bridge. An undersized bridge opening can cause water to back up upstream of the bridge, reducing stream velocity, which results in sediment deposition. In high stage, the floodwater may seek conveyance through alternative paths, forming new channels around the bridge constriction.

Bank erosion, left

The erosion observed here on the left bank is the start of a flanking process that may eventually threaten the stability of Lady's Bridge. This site has been monumented as a Bank Erosion Monitoring Site (BEMS 17-09386). In a prioritization of twenty-one BEMS sites throughout the West Kill watershed (see Section 3.3, Watershed Inventory and Assessment), this site was ranked Low Priority. The *thalweg*, or deepest part of the stream channel flows up against the alluvial terrace here. The terrace is being undermined by toe erosion, leaving vegetation overhanging the channel. Increasing valley confinement and healthy riparian buffer suggest a potential for self-recovery here. Continued monitoring is recommended at this site to determine the rate of bank retreat and degree of hazard posed to the bridge.

Sediment Transport

Streams move sediment as well as water. Channel and floodplain conditions determine whether the reach aggrades, degrades, or remains in balance over time. If more sediment enters than leaves, the reach aggrades. If more leaves than enters, the stream degrades (See Section 3.1 for more details on Stream Processes).

Marked reduction landform slope and confinement in this unit disrupt sediment transport continuity here. Ineffective conveyance of bedload through the unit results in extensive bedload storage, rapid aggradation and shifting channels. Sediment storage reaches such as found in this unit may benefit the stability of the overall stream system. Settings like

these should be identified and preserved where adjacent land use permits. Mature riparian vegetation will be important in such settings to limit the extent of lateral channel migration and bank erosion.

Riparian Vegetation

One of the most cost-effective methods for landowners to protect streamside property is to maintain or replant a healthy buffer of trees and shrubs along the bank, especially within the first 30 to 50 ft. of the stream. A dense mat of roots under trees and shrubs bind the soil together, and makes it much less susceptible to erosion under flood flows. Mowed lawn does not provide adequate erosion protection on stream banks because it typically has a very shallow rooting system. Interplanting with native trees and shrubs can significantly increase the working life of existing rock rip-rap placed on streambanks for erosion protection. *Riparian*, or streamside, forest can buffer and filter contaminants coming from upland sources or overbank flows. Riparian plantings can include a great variety of flowering trees and shrubs, native to the Catskills, which are adapted to our regional climate and soil conditions and typically require less maintenance following planting and establishment.

Some plant species that are not native can create difficulties for stream management, particularly if they are invasive. Japanese knotweed (*Fallopia japonica*), for example, has become a widespread problem in recent years. Knotweed shades out other species with it's dense canopy structure (many large, overlapping leaves), but stands are sparse at ground level, with much bare space between narrow stems, and without adequate root structure to hold the soil of streambanks. The result can include rapid streambank erosion and increased surface runoff impacts.

An analysis of vegetation was conducted using aerial photography from 2005 and field inventories (Fig. 4.17.3). Japanese knotweed occurrences were documented as part of the stream feature inventory conducted during the summer of 2004, with additional occurrences identified in 2005.

In this management unit, the predominant vegetation type within the 300 ft. riparian buffer is Forest (30 %) followed by Shrubland (25 %). *Impervious* area (4%) within this unit's buffer is primarily the Greene County Route 6, along with private residences and associated roads. Twelve occurrences of Japanese knotweed were documented in this management unit during the 2004 stream inventory, 31 were documented in 2005.

National Wetland Inventory wetlands in MU17

There are 8 wetlands within this management unit mapped in the National Wetland Inventory (see Section 2.5, Wetlands and Floodplains for more information on the National Wetland Inventory and wetlands in the West Kill watershed). Wetlands are important features in the landscape that provide numerous beneficial functions including protecting and improving water quality, providing fish and wildlife habitats, storing floodwaters, and maintaining surface water flow during dry periods (See Section 2.6 for wetland type descriptions and regulations). The most upstream wetlands, one measuring 0.8 acres in size, the other measuring 0.1 acres, are both designated *palustrine, emergent, broad-leaved deciduous, seasonally flooded/saturated* (PEM1E). Moving downstream, the next wetland is 3.5 acres in size, and is designated *palustrine, scrub/shrub, broad-leaved deciduous, seasonally flooded/saturated* (PSS1C). Continuing downstream, there is a 3.3 acre wetland and 0.4 acre wetland that are both designated *riverine, lower perennial, unconsolidated shore, temporarily flooded*(R2USA), a 2 acre wetland that is designated *palustrine, scrub/shrub, broad-leaved deciduous, seasonally flooded* (PSS1C) and a 16.1 acre wetland that is designated *palustrine, forested, broad-leaved deciduous temporarily flooded* (PFO1A). There is also a small wetland measuring 0.3 acres that is designated *palustrine, unconsolidated bottom, semipermanently flooded, diked/impounded* (PUBFh).

Areas of herbaceous (non-woody) cover present opportunities to improve the riparian buffer with tree plantings, to promote a more mature vegetation community along the streambank and in the floodplain. In November 2005, suitable riparian improvement planting sites were identified through a watershed-wide remote evaluation of current riparian buffer conditions and existing stream channel morphology. These locations indicate where plantings of trees and shrubs on and near stream banks can help reduce the threat of serious bank erosion, and can help improve aquatic habitat as well. In some cases, eligible locations include stream banks where rock rip-rap has already been placed, but where additional plantings could significantly improve long-term stream channel stability, as well as biological integrity of the stream and floodplain. Areas with serious erosion problems where the stream channel requires extensive reconstruction to restore long-term stability have been eliminated from this effort. In many cases, these sites can not be effectively treated with riparian enhancement alone, and full restoration efforts would include channel restoration components in addition to vegetative treatments.

Sixty-nine potential planting sites were documented within this management unit (4.17.4).

Recommendations for this site include planting native trees and shrubs along the edge of the stream bank and the upland area. Buffer width should be increased by the greatest amount agreeable to the landowners, but increasing the buffer width by at least 35 feet will increase the buffer functionality and improve stream bank stability while still allowing a significant lawn area.

Flood Threats

100-year floodplain boundary in Management Unit 17

Inundation

As part of its National Flood Insurance Program (NFIP), the Federal Emergency Management Agency (FEMA) performs hydrologic and hydraulic studies to produce Flood Insurance Rate Maps (FIRM), which identify areas prone to flooding. The NYS DEC Bureau of Flood Protection is currently developing new floodplain maps for the West Kill on the basis of recent surveys. These maps should be completed for the West Kill in 2006.

According to this existing floodplain maps, there are no houses located within the 100-year floodplain boundary in this management. The 100-year floodplain is that area predicted to be inundated by floods of a magnitude that is expected to occur once in any 100 year period, on the basis of a statistical analysis of the local flood record. Most communities regulate the type of development that can occur in areas subject to these flood risks. The current NFIP maps are available for review at the Greene County Soil & Water Conservation District office.

Bank Erosion

Most of the stream banks within the management unit are considered stable, but 36% (1967 ft.) of the stream is experiencing significant erosion. There are two Bank Erosion Monitoring sites in MU17 (BEMS 17-14571 and 17-09386).

Infrastructure

Twenty percent of the stream length in this management unit has been treated with some form of revetment. Recommendations for the unit call for a cooperative, multi-institutional effort including NYCDEP, GCSWCD, NYSDEC and NYS Department of Transportation, to evaluate the status of the revetment in the unit and develop an integrated strategy to improve both revetment stability and the functionality of the vegetative buffer.

Aquatic Habitat

It is recommended that a habitat study be conducted on the West Kill Creek, with particular attention paid to possible temperature barriers in aggrading sections, to the frequency of disturbance of the bed due to incision at numerous points in the system, and to embeddedness resulting from excessive entrainment of fine sediment.

Habitat value in this unit is difficult to quantify. Woody debris and shallow margins are abundant, and high diversity of bedform was evident. However, high width-depth ratios, in combination with poor canopy cover, may result in thermal impacts. In addition, the frequency of disturbance may limit the development of a healthy macroinvertebrate community.

Water Quality

Clay exposures and sediment from stream bank and channel erosion pose a potential threat to water quality in West Kill Creek. Clay and sediment inputs into a stream may increase *turbidity* and act as a carrier for other pollutants and pathogens. There was one significant clay exposure identified in the 2004 Inventory, and no clay exposures identified in 2005,

Stormwater runoff can also have a considerable impact on water quality. When it rains, water falls on roadways and flows untreated directly into West Kill Creek. The cumulative impact of oil, grease, sediment, salt, litter and other unseen pollutants found in road runoff can significantly degrade water quality. There is one stormwater culvert in this management unit,

Nutrient loading from failing septic systems is another potential source of water pollution. Leaking septic systems can contaminate water making it unhealthy for swimming or wading. There are numerous houses located in close proximity to the stream channel in this management unit. These homeowners should inspect their septic systems annually to make sure they are functioning properly. Each household should be on a regular septic service schedule to prevent over-accumulation of solids in their system. Servicing frequency varies per household and is determined by the following factors: household size, tank size, and presence of a garbage disposal. Pumping the septic system out every three to five years is recommended for a three-bedroom house with a 1,000-gallon tank; smaller tanks should be pumped more often.

The New York City Watershed Memorandum of Agreement (MOA) allocated 13.6 million dollars for residential septic system repair and replacement in the West-of-Hudson Watershed through 2002. Eligible systems included those that were less than 1,000-gallon capacity serving one- or two-family residences, or home and business combinations. One homeowner in this management unit made use of this program to replace or repair a septic system.

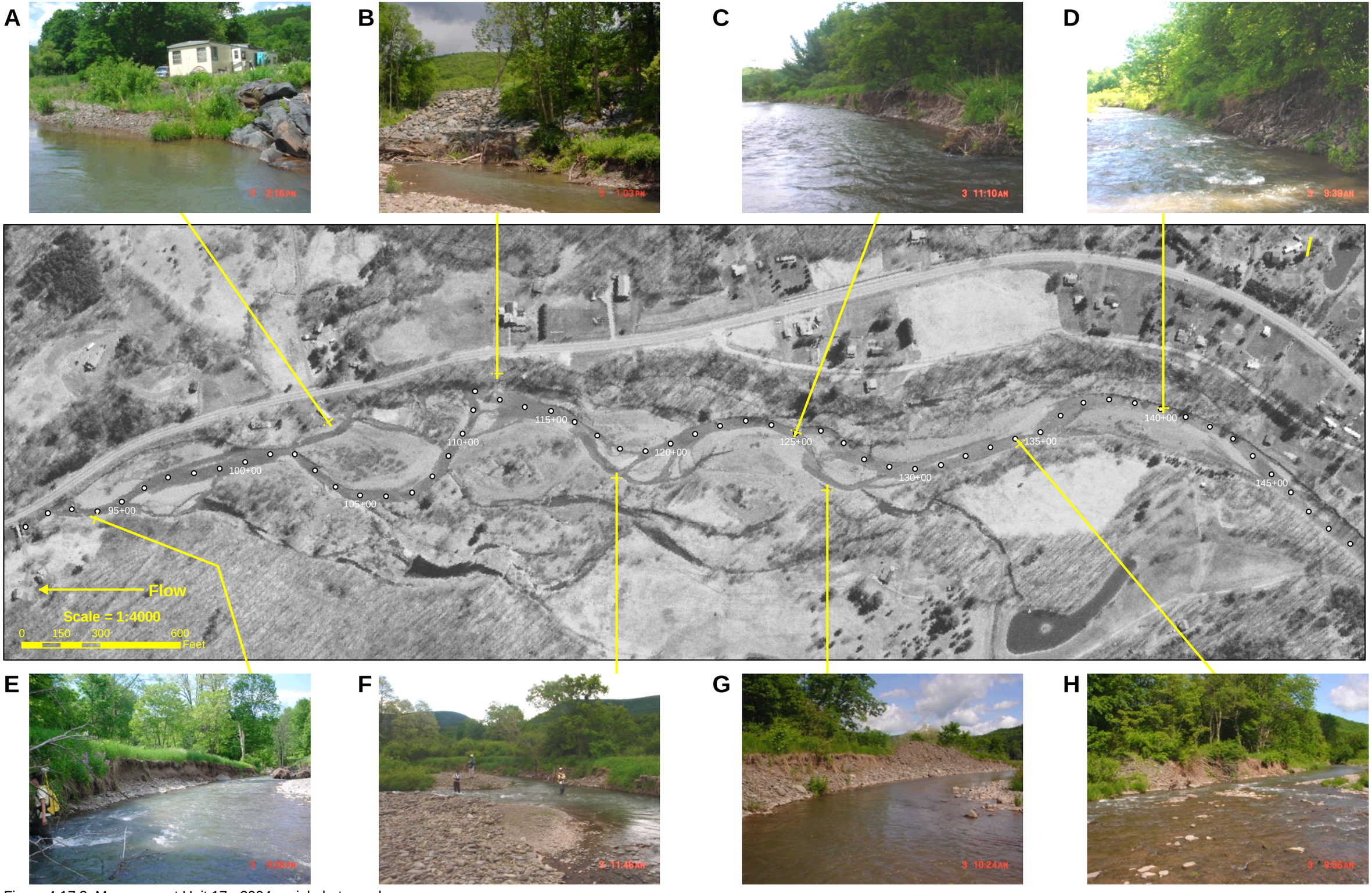


Figure 4.17.2 Management Unit 17 - 2004 aerial photography